REMARKS

Applicants appreciate the thoroughness with which the Examiner has examined the above-identified application. Reconsideration is requested in view of the amendments above and the remarks below.

Rejections under 35 U.S.C. § 101

The Examiner has rejected claims 1-30 under 35 U.S.C. § 101 because the claimed invention is directed to non-statutory subject matter. Specifically, the Examiner asserts that the current state of the claim language is such that a reasonable interpretation of the claims would not result in any useful, concrete, or tangible product.

The present invention relates to the simulation of a wavefront and the incorporation of a phase map to analytically account for flare in optical proximity correction of photolithographic masks. It computes "a phase map that can be used to take into account the higher order aberrations within an optical proximity correction simulation kernel, which results in a more accurate computation of OPC when long-range effects become prominent." Specification, ¶ 0046.

> *A phase map is created* from either a simulated wavefront or an empirically derived wavefront by analytically embedding the wavefront on an array having a significant number of guard band zeros, and performing an inverse Fourier transform on the resultant array. Following the inverse Fourier transform, the pixel dimension is then converted to the nominal dimension for implementation with OPC kernels.

Specification, ¶ 0058 (emphasis added).

> The method to *generate the phase map* is the same whether the wavefront is obtained from simulated data or empirically derived information.

Specification, ¶ 0059 (emphasis added).

Applicants have amended the independent claim 1, 26 and 27 to more clearly define that the final result of implementing the present methodology is a phase map modified for optical proximity correction. Applicants have further added new claims 31, 32 and 33 to delineate the tangible product produced by the claimed invention.

Rejections under 35 U.S.C. § 103

Claims 1-3, 20-21, and 27-29 stand rejected under 35 U.S.C. § 103(a) as being obvious from Baggenstoss, et al. (U.S. Patent No. 6,374,396), in view of Neureuther, et al. (U.S. Patent No. 7,030,997). Applicant respectfully traverses this rejection.

The present invention remains patentably distinct over the cited prior art of Baggenstoss in that only the present invention's methodology includes higher order aberrations. Specifically, Baggenstoss is dependent upon the intensity determinations using the Zernike polynomial, which excludes higher order effects. "The Zernike polynomial results from the wavefront function for optical systems with circular pupils and describes lens aberrations. If the Zernike coefficient (Z) values are known across the field of exposure (Z_i=f(x,y), with x,y as coordinates in the field), intensity may be calculated as a function of the field coordinates." Baggenstoss, col. 5, ll.37-42. Baggenstoss does select a correction model for each of the zones within a field of the mask; however, the correction models taught and suggested by Baggenstoss do not include models for determining the higher order values because of Baggenstoss' dependency on the Zernike polynomial calculations for intensity. Moreover, Baggenstoss relies on optical proximity correction tools currently in the art, such as the OPC tool available from Avanti Corp., of Fremont, California. Baggenstoss, col. 5, ll.9-11. As noted by Baggenstoss, such tools produce uniform intensity across the field of exposure or otherwise ignore inherent variations. These tools do not accommodate

higher order effects. Baggenstoss relies on calculations using the Zernike polynomial, which means that Baggenstoss also does not accommodate higher order effects; rather, the emphasis is on the lower order aberrations.

The present invention specifically takes into account the higher order effects of these aberrations.

> *Inverse Fourier transforms are used to create a phase map that accounts for higher order aberrations normally ignored in traditional optical proximity correction (OPC) simulation kernels.* Two methodologies are proposed to account for the higher order aberrations. The first method utilizes simulated wavefront information from randomly generated data. The second method uses measured or empirically derived data from optical tools.

Specification, ¶ 0047 (emphasis added).

In accounting for higher order aberrations, one cannot rely on OPC tools that do not consider the higher order effects, or on methodologies that utilize the Zernike polynomial, as does Baggenstoss. Applicants have amended the independent claims of the present invention to specifically state that the methodology creates a phase map that accounts for higher order aberrations.

Neureuther teaches using the Zernike polynomial as well, which by its nature excludes higher order aberration effects.

> The sensitivity and orthogonality of four targets designed for coma, astigmatism, trefoil and spherical aberrations to the corresponding 8 Zernike aberrations is assessed, and the accuracy and speed of the approach with automatic wafer inspection are estimated.

Neureuther, col. 6, ll.41-46.

> The general strategy for designing defect-probe based targets for different Zernike aberrations consists of three steps. 1) Characterizing the point spread electric field (PSEF) for a particular Zernike aberration. 2) Building-up target sensitivity for the Zernike aberration under consideration by inversely mapping the point spread electric field (PSEF) to locate positions and phases of target components that coherently add electric fields at the central defect-probe position. 3) Reducing target sensitivity to other Zernike

> aberrations by adding components to create the rotational angular dependence associated with the aberration under test.

Neureuther, col. 8, ll.23-36.

Applicants respectfully submit that the amendments made to claims 1, 26 and 27 distinguish the present invention over the cited prior art of Baggenstoss and Neureuther.

Rejections under 35 U.S.C. § 102

The Examiner has rejected claim 26 under 35 U.S.C. § 102(b) as being anticipated by Wong, et al. (U.S. Patent No. 6,223,139). Applicants traverse this rejection.

Wong requires determining a sample range and spatial sampling intervals, which are dependent upon the wavelength, numerical aperture, and partial coherence of the exposure system. Wong chooses to eliminate higher order aberrations due to the complexity and inefficiency of the computations. "Since the imaging system is band-limited, i.e., it passes low spatial frequencies but cuts off high frequencies, the sampling interval is given by: $d\lambda/(NA(1+\sigma))$, where d=0.5." Wong, col. 7, l.65 – col. 8, l.6.

> For partially coherent systems, optical interaction among patterns on the photomask has a finite range. In aerial image computation, the use of a sampling range smaller than the interaction range results in inaccurate calculation. On the other hand, the use of an unnecessarily large sampling range increases the size of the characteristic matrix and, hence, reduces computation efficiency.

Wong, col. 8, ll.12-18.

Moreover, Wong's method is characterized in that the characteristic matrix is precisely defined by the sampling range and the sampling interval, such that the sampling range is the shortest possible and the sampling interval, the largest possible, without sacrificing accuracy. Wong, abstract.

Thus, like the other cited prior art, Wong too does not accommodate higher order aberrations, and in fact, teaches away from using calculations that would account for higher order aberrations by eliminating large sample ranges from consideration. Applicants submit that the amendments made to claim 26 regarding the specific accommodation for higher order effects, distinguishes the present invention over the cited prior art of Wong.

Allowable Subject Matter

The Examiner has objected to claims 4-19, 22-25, and 30 as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims, as well as overcoming the 35 U.S.C. § 101 rejections further identified. Applicants respectfully submit that the amendments to claims 1 and 27 place the above-objected claims in a condition for allowance.

It is respectfully submitted that the entire application has now been brought into a condition where allowance of the entire case is proper. Reconsideration and issuance of a notice of allowance are respectfully solicited.

Respectfully submitted,

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Name: Barbara Browne Date: January 16, 2007 Signature: ______________

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